Elongation and Fluctuations of Semi-flexible Polymers in a Nematic Solvent

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We have explored the behavior of polymer coils in a nematic solvent. In particular, we carried out the first direct experimental investigation of isolated semi-flexible polymers dissolved in a background nematic phase composed of aligned rod-like macromolecules. We showed by direct visualization that semi-flexible biopolymers in the nematic phase assume an elongated rod-like configuration aligned with the background nematic director. The coil-rod transition of the biopolymer can be tuned by varying the concentration of rods in the background solvent so that the solvent undergoes an isotropic-nematic (I-N) transition. We also directly observe the existence of hairpin defects in the system.

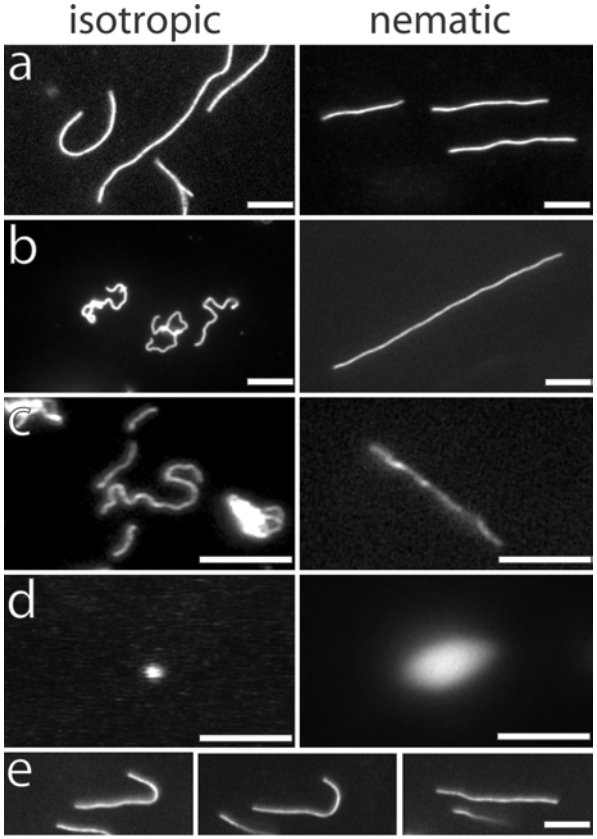

FIG. 1: Images of fluorescently labeled biopolymers in the isotropic (left) and nematic (right) phase of fd virus. Figures (a)-(d) are, respectively, the images of actin, Wormlike micelles, neurofilaments, and DNA. (e) A sequence of images illustrating an actin filament escaping From a hairpin defect. The scale bar is 5 μm.

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Education:

One graduate student (Jian Zhang) and one postdoc (Zvonomir Dogic) contributed to this work. This work is also under several groups collaboration. The collaborating groups are from Institute for Medicine and Engineering. (Paul Janmey's group, whose postdoc Helim Aranda-Espinoza participated this work, and Dennis Discher's group, whose graduate student Paul Dalhaimer participated this work.) We also had theoretical contributions from Tom Lubensky (Physics) and his post-doc Andy Lau.